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## New Species of Winter Stoneflies of the Genus *Allocaonia* (Plecoptera, Capniidae)

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Due in no small part to collections made by about seventy biologists in response to recent requests, a number of unexpected circumstances have appeared concerning the winter stonefly genus *Allocaonia*. Especially in the southern part of the range of the genus (comprising the temperate deciduous forest of eastern North America), several new species appear to give some of our first tangible evidence pointing to the probable geographic origin of several species complexes.

### DESCRIPTIONS OF NEW SPECIES

Unless otherwise noted, all the species described herein possess the following characteristics: length from tip of head to end of abdomen about 5 mm in the male and 6 mm in the female; color dark brown, the wings slightly smoky with brown veins; general structure as described for other species in the genus. In the females the wings extend beyond the tip of the abdomen. Known diagnostic characters occur only in the genital structures associated with the seventh and eighth segments and posteriorly.

#### *Allocaonia brooksi* new species

*Male*.—Wings reaching only to fourth tergite. Seventh tergite without dorsal process, Fig. 1. Dorsal process of eighth tergite with lateral aspect having a sharp anterior shoulder

and sharply pointed tip, its posterior aspect evenly arcuate. Supra-anal process short and stocky.

*Holotype* ♂ and 1 ♂ *paratype*.—Two miles west of Sevierville, Sevier Co., TENNESSEE, Feb. 1, 1963, Stannard & Brooks.

The process of the eighth tergite indicates that this species is very close to *vivipara* (Claassen), from which it differs in the well developed wings and in the sharp anterior shoulder of the process of the eighth tergite. Thus *brooksi* is an early offshoot of the *vivipara* stem, arising before the loss of wings occurred in the male.

### ***Allocapnia malverna* new species**

*Male*.—Wings reaching fifth tergite. Seventh tergite without dorsal process, Fig. 2. Dorsal process of eighth tergite fairly high and abrupt, lateral aspect higher anteriorly, posterior aspect broad and truncate. Upper supra-anal process moderately wide and deep, with the apical portion slightly swollen and the tip somewhat pointed, the apical segment about one and one-half times length of basal segment.

*Holotype* ♂ and 4 ♂ *paratypes*.—10-Mile Creek south of Malvern, Hot Springs Co., ARKANSAS, Feb. 1, 1961, Ross & Ross.

This species combines characters of the *recta* and *mystica* complexes. From *recta* (Claassen) and its allies this species differs in the deeper and markedly articulated upper supra-anal process; from *mystica* (Frison) and its allies it differs in lacking a deep incision in the posterior aspect of the eighth tergite. From this comparison it is clear that *malverna* is probably the most primitive known species in the *recta* complex.

### ***Allocapnia wrayi* new species**

*Male*.—Wings reaching fifth tergite. Seventh tergite with no dorsal hump, Fig. 3. Process of eighth tergite steep and high, the rugose lobes situated near posterior margin and separated by a narrow but deep cleft. Upper supra-anal process fairly narrow and deep, the apical lobe slightly clavate and slightly to markedly longer than basal lobe.

*Holotype* ♂, *allotype* ♀, and 2 ♂ *paratypes*.—Richmond, VIRGINIA, Feb. 21, 1962, D. W. Adams. *Paratypes*.—Many ♂, ♀ from the type locality and from the following localities in NORTH CAROLINA: Berea, Burlington, Durham, Pinnacle, Summerfield, and west of Salem.

This species is a close relative of *mystica* Frison, from which it differs in the long apical segment of the supra-anal process. Whereas *mystica* occurs west of the Appalachian system, *wrayi* appears confined to the east of it. Both species appear to be confined to the southern half of the range of the genus.

### ***Allocapnia zekia* new species**

*Male*.—Wings reaching fifth segment. Seventh tergite with posterior two-thirds elevated into a round, prominent hump, the portion of the segment anterior to the hump forming a continuous sclerotized band, Fig. 4. Process of eighth tergite high and massive, the rugose lobes set well forward on the process and separated by a fairly deep cleft. Upper supra-anal process only moderately wide, the apical segment slightly bulbous and markedly longer than basal segment.

*Holotype* ♂.—Zekiah Swamp, La Plata, Charles Co., MARYLAND, Feb. 28, 1962, J. Allison, T. Hopkins, R. J. Rubelmann.

This species is closely related to *wrayi* and *mystica*, differing in the longer apical segment of the upper supra-anal process and the peculiar dorsal hump of the seventh tergite.

### ***Allocapnia jeanae* new species**

*Male*.—Wings just barely reaching fourth segment. Seventh tergite without dorsal process, Fig. 5. Process of eighth tergite high, steep, and massive, its lateral aspect almost as wide as the tergite is long, the rugose lobes placed far forward, separated by a deep but narrow cleft, the posterior corners of the process forming almost right-angled lobes. Basal segment of the upper supra-anal process greatly elongated, about three times as long as the apical segment.

*Female*.—Seventh and eighth sternites joined by a fairly broad mesal strap; apex of eighth sternite with a triangular smooth area.

*Holotype* ♂, *allotype* ♀ and 7 ♂, 1 ♀ *paratypes*.—West Fork of White River, Winslow, Washington Co., ARKANSAS, Feb. 14, 1961, Ross & Ross. *Paratypes*.—♂, ♀ from the following localities in ARKANSAS: Carroll Co. (Dryfork Creek), Madison Co. (Cannon Creek, Combs, Henderson Creek, Huntsville), Washington Co. (West Fork).

This species, a highly specialized offshoot of the *mystica* complex, differs from all described species by the large and massive process of the eighth tergite and the extremely long upper supra-anal process.

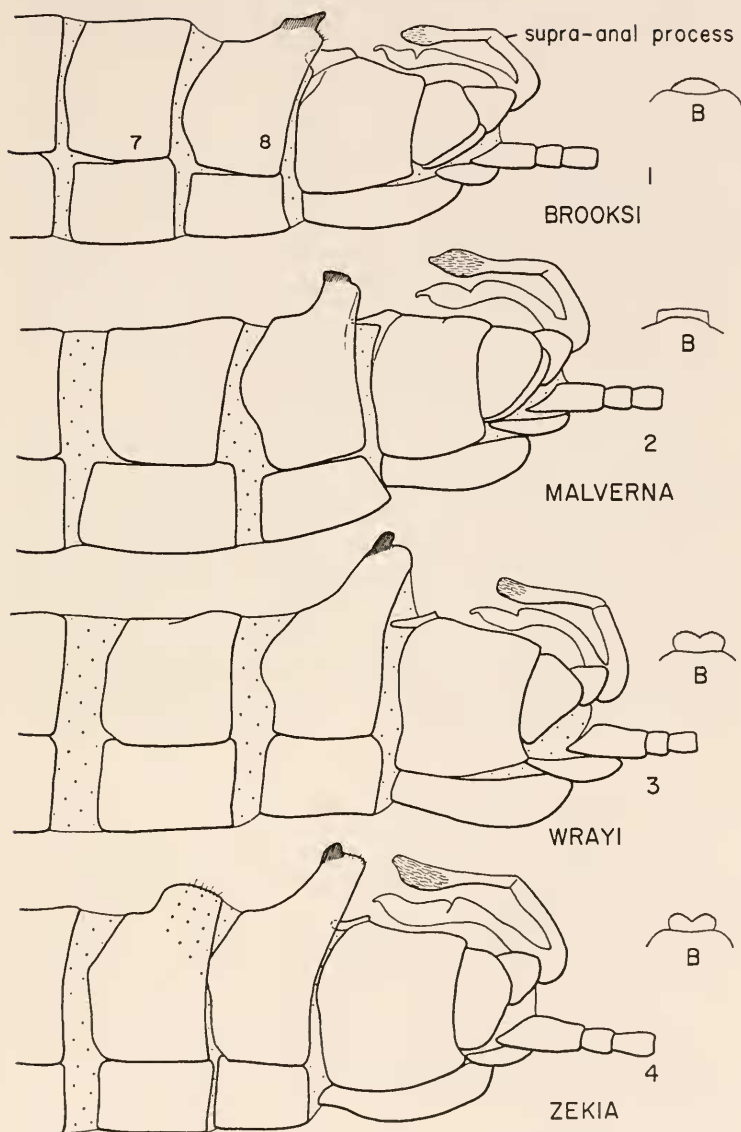
### ***Allocapnia ozarkana* new species**

*Male*.—Wings extending only over third tergite. Seventh tergite with a raised process almost as high as that on eighth, situated on the posterior half of the segment, the apical projection narrow in lateral view, fairly narrow and cleft in posterior view, Fig. 6. Process of eighth tergite moderately high, the rugose processes situated near the posterior margin, their posterior aspect wide and separated by a wide, deep notch. Upper supra-anal process with apical segment short and somewhat sagittate, basal segment very long.

*Holotype* ♂ and 3 ♀ *paratypes*.—Cannon Creek, Madison Co., ARKANSAS, Jan. 26, 1962, L. O. Warren.

In structure of the eighth tergite and supra-anal process this species is almost exactly like *forbesi* Frison, differing from *forbesi* primarily in the small cleft process of the seventh tergite, which in *forbesi* is massive and conical. Although the females of *ozarkana* have not been associated definitely with the male, several specimens from Washington County, Arkansas, resemble those of *forbesi* very closely and would therefore appear to belong to *ozarkana*.

Other relatives of *forbesi* (known from southern Illinois to southern Ohio) occur in the northeastern states. This discovery of *ozarkana* demonstrates that some progenitors of the existing



FIGS. 1-4. Apex of abdomen of *Allocapnia*, lateral aspect. A, B, posterior view of dorsal process of seventh and eighth segments, respectively.

members of the group effected a dispersal between the Ozark mountain system and the Appalachian region.

### ***Allocapnia fumosa* new species**

*Male*.—Wings entirely covering fourth tergite, in slightly contracted specimens reaching the fifth. Seventh tergite without a process, Fig. 7. Process of eighth tergite high, the entire dorsal part of the segment forming a steep and massive prominence; rugose areas V-shaped from dorsal view, flanked on each side by a round lobe which is part of the segment and does not form a finger-like projection. Upper supra-anal process narrow, the apical segment longer than the basal one.

*Holotype* ♂.—Great Smoky Mountain National Park, 2 miles west of Gatlinburg, Sevier Co., TENNESSEE, Feb. 1, 1963, Stannard & Brooks. *Paratype*.—NORTH CAROLINA: Canton, Poison Cove Branch, Henson Cove, Jan. 20, 1964, C. D. Pless, 1 ♂.

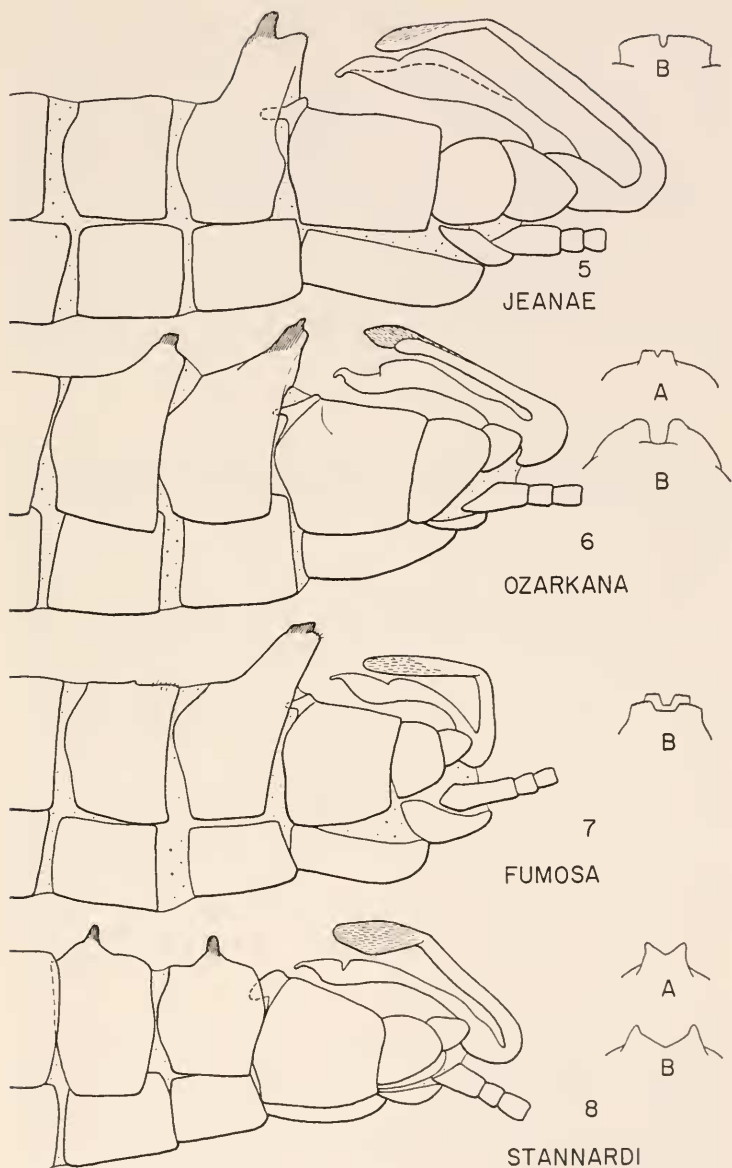
The V-shaped rugose areas of the eighth tergite indicate that this species is a member of the *granulata* complex but *rugosa* differs from any of these species in lacking a finger-like lobe on each side of the rugose areas. This suggests very strongly that *rugosa* may represent the progenitor of the *granulata* complex, and may be an archaic offshoot of the complex that arose before these finger-like lobes evolved.

### ***Allocapnia stannardi* new species**

*Male*.—Wings reaching fifth tergite. Seventh tergite with a high process, its lateral view narrow and sharp, its posterior view wide, parallel sided, and cleft at apex, Fig. 8. Process of eighth tergite moderately high and divided into a pair of widely separated, somewhat conical lateral lobes. Upper supra-anal process long, its apical segment short and moderately swollen.

*Female*.—Seventh and eighth sternites fused, at present indistinguishable with certainty from those of *rickeri* Frison.

*Holotype* ♂, *allotype* ♀, and 32 ♂, ♀ *paratypes*.—Great Smoky Mountain National Park, one mile east of Walker Prong Branch, Sevier Co., TENNESSEE, Feb. 1, 1963, Stannard & Brooks. *Paratypes*.—Many ♂, ♀ all collected by Stannard &



FIGS. 5-8. Apex of abdomen of *Allocapnia*, lateral aspect. A, B, posterior view of dorsal process of seventh and eighth segments, respectively.

Brooks, Jan. 31 or Feb. 1, 1963.—NORTH CAROLINA: Jackson Co. (Cherokee and Dillsboro); TENNESSEE: Same data as *holotype* but Walker Prong Bridge, bridge at Sugarland Branch, and mouth of Cole Branch.

The process of the eighth tergite and the supra-anal process are exactly like those of *rickeri*, to which this species is closely related. The diagnostic feature of *stannardi* is the peculiar process of the seventh tergite.

Another peculiarity of this species is that it is the only one of the genus known to inhabit and be restricted to the cascade-like and practically boreal streams of the Great Smoky Mountains.

#### BIOGEOGRAPHIC IMPLICATIONS

The identification of relatively primitive forms such as *brooksi*, *fumosa*, and *terayi*, together with relatively specialized forms such as *zekia* and *stannardi*, in the southeastern quadrant of the range of *Allocapnia* indicates that a considerable amount of the evolution in this genus has occurred in association with the southern portion of the Appalachian system. An almost identical type of species combination, involving the relatively primitive species *malvernana* and *osarkana* and the highly specialized species *jeanae* found only in the Ozark-Ouachita mountains of western Arkansas and eastern Oklahoma, is excellent evidence that a comparable evolutionary development of *Allocapnia* occurred in this area also. It is evident further, considering previously described species in the genus, that progenitor stocks of these and other species have in the past dispersed between the Ozark and Appalachian systems, that these more extensive ranges were subsequently broken, and the isolated portions evolved into distinctive species. There is therefore emerging a picture of successive dispersals and isolations of these temperate deciduous forest animals, and the consequent evolution of at least two polyphyletic clusters of species, one in the southern Appalachians and one in the Ozarks. It seems probable that climatic fluctuations of some sort associated with the Pleistocene were responsible in large measure for the changes in geographic ranges responsible for this evolutionary pattern.



## ACKNOWLEDGMENTS

I want to express my gratitude to the many biologists who have cooperated in our survey of the winter stonefly genus *Allocaenia* in eastern North America. Particular individuals who have been responsible for much of the material reported in this paper are those listed as collectors of the type material. I also want to express appreciation to Mrs. Alice Prickett who made the illustrations.

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## Additions and Corrections to the World List of Type-Species of Chloropidae (Diptera)

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In 1941 I published "An annotated list of genotypes of the Chloropidae of the world (Diptera)" (*Ann. Ent. Soc. Amer.* 34: 735-765, with minor corrections in 1942, loc. cit. 35: 478). A few corrections are necessary, a few old genera have been found to belong to the Chloropidae, and a few additional genera have been published since that time. The arrangement of the present supplement is alphabetical under each subfamily, as in the original list; but the format of individual entries has been simplified. Names that are additions to the list are in capital letters. References are given in full only where they are not in the original list.

## SUBFAMILY CHLOROPINAE

ARAGARA Walker, 1860, Jour. Linn. Soc. London, Zool. 4: 154. 1 species. Type-species, *A. crassipes* Walker (monotypy). This was originally described in Walker's subfamily

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